

**$\phi(1680)$**  $I^G(J^{PC}) = 0^-(1^- -)$  **$\phi(1680)$  MASS** **$e^+e^-$  PRODUCTION**

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>1680 \pm 20</math> OUR ESTIMATE</b>				
1689 $\pm$ 7	10	4.8k	1 SHEN	09 BELL 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$
1709 $\pm$ 20	43		2 AUBERT	08S BABR 10.6 $e^+e^- \rightarrow$ hadrons
1623 $\pm$ 20	948		3 AKHMETSHIN 03	CMD2 1.05–1.38 $e^+e^- \rightarrow K_L^0 K_S^0$
$\sim 1500$			4 ACHASOV	98H RVUE $e^+e^- \rightarrow \pi^+\pi^-\pi^0, \omega\pi^+\pi^-$ , $K^+K^-$
$\sim 1900$			5 ACHASOV	98H RVUE $e^+e^- \rightarrow K_S^0 K^\pm\pi^\mp$
1700 $\pm$ 20			6 CLEGG	94 RVUE $e^+e^- \rightarrow K^+K^-, K_S^0 K\pi$
1657 $\pm$ 27	367		7 BISELLO	91C DM2 $e^+e^- \rightarrow K_S^0 K^\pm\pi^\mp$
1655 $\pm$ 17			8 BUON	88B DM2 $e^+e^- \rightarrow K^+K^-$
1680 $\pm$ 10			9 MANE	82 DM1 $e^+e^- \rightarrow$ hadrons
1677 $\pm$ 12				82 DM1 $e^+e^- \rightarrow K_S^0 K\pi$

1 From a fit with two incoherent Breit-Wigners.

2 From the simultaneous fit to the  $K\bar{K}^*(892) +$  c.c. and  $\phi\eta$  data from AUBERT 08S using the results of AUBERT 07AK.3 From the combined fit of AKHMETSHIN 03 and MANE 81 also including  $\rho$ ,  $\omega$ , and  $\phi$ . Neither isospin nor flavor structure known.

4 Using data from IVANOV 81, BARKOV 87, BISELLO 88B, DOLINSKY 91, and ANTONELLI 92.

5 Using the data from BISELLO 91C.

6 Using BISELLO 88B and MANE 82 data.

7 From global fit including  $\rho$ ,  $\omega$ ,  $\phi$  and  $\rho(1700)$  assume mass 1570 MeV and width 510 MeV for  $\rho$  radial excitation.8 From global fit of  $\rho$ ,  $\omega$ ,  $\phi$  and their radial excitations to channels  $\omega\pi^+\pi^-$ ,  $K^+K^-$ ,  $K_S^0 K_L^0$ ,  $K_S^0 K^\pm\pi^\mp$ . Assume mass 1570 MeV and width 510 MeV for  $\rho$  radial excitations, mass 1570 and width 500 MeV for  $\omega$  radial excitation.9 Fit to one channel only, neglecting interference with  $\omega$ ,  $\rho(1700)$ .**PHOTOPRODUCTION**

VALUE (MeV)		DOCUMENT ID	TECN	COMMENT
<b>We do not use the following data for averages, fits, limits, etc. • • •</b>				
1753 $\pm$ 3		10 LINK	02K FOCS	20–160 $\gamma p \rightarrow K^+K^-p$
1726 $\pm$ 22		10 BUSENITZ	89 TPS	$\gamma p \rightarrow K^+K^-X$
1760 $\pm$ 20		10 ATKINSON	85C OMEG	20–70 $\gamma p \rightarrow K\bar{K}X$
1690 $\pm$ 10		10 ASTON	81F OMEG	25–70 $\gamma p \rightarrow K^+K^-X$
10 We list here a state decaying into $K^+K^-$ possibly different from $\phi(1680)$ .				

 **$p\bar{p}$  ANNIHILATION**

VALUE (MeV)		DOCUMENT ID	TECN	COMMENT
<b>We do not use the following data for averages, fits, limits, etc. • • •</b>				
1700 $\pm$ 8		11 AMSLER	06 CBAR	0.9 $\bar{p}p \rightarrow K^+K^-\pi^0$
11 Could also be $\rho(1700)$ .				

 **$\phi(1680)$  WIDTH** **$e^+e^-$  PRODUCTION**

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
<b><math>150 \pm 50</math> OUR ESTIMATE</b> This is only an educated guess; the error given is larger than the error on the average of the published values.				
<b>• • • We do not use the following data for averages, fits, limits, etc. • • •</b>				
211 $\pm$ 14	19	4.8k	12 SHEN	09 BELL 10.6 $e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$
322 $\pm$ 77	160		13 AUBERT	08S BABR 10.6 $e^+e^- \rightarrow$ hadrons
139 $\pm$ 60	948		14 AKHMETSHIN 03	CMD2 1.05–1.38 $e^+e^- \rightarrow K_L^0 K_S^0$
300 $\pm$ 60			15 CLEGG	94 RVUE $e^+e^- \rightarrow K^+K^-, K_S^0 K\pi$
146 $\pm$ 55	367		16 BISELLO	91C DM2 $e^+e^- \rightarrow K_S^0 K^\pm\pi^\mp$
207 $\pm$ 45			17 BISELLO	88B DM2 $e^+e^- \rightarrow K^+K^-$
185 $\pm$ 22			18 BUON	82 DM1 $e^+e^- \rightarrow$ hadrons
102 $\pm$ 36				82 DM1 $e^+e^- \rightarrow K_S^0 K\pi$

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NODE=M067W1

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- 12 From a fit with two incoherent Breit-Wigners.  
 13 From the simultaneous fit to the  $K\bar{K}^*(892) +$  c.c. and  $\phi\eta$  data from AUBERT 08S using the results of AUBERT 07AK.  
 14 From the combined fit of AKHMETSHIN 03 and MANE 81 also including  $\rho$ ,  $\omega$ , and  $\phi$ . Neither isospin nor flavor structure known.  
 15 Using BISELLO 88B and MANE 82 data.  
 16 From global fit including  $\rho$ ,  $\omega$ ,  $\phi$  and  $\rho(1700)$   
 17 From global fit of  $\rho$ ,  $\omega$ ,  $\phi$  and their radial excitations to channels  $\omega\pi^+\pi^-$ ,  $K^+K^-$ ,  $K_S^0K_L^0$ ,  $K_S^0K^\pm\pi^\mp$ . Assume mass 1570 MeV and width 510 MeV for  $\rho$  radial excitations, mass 1570 and width 500 MeV for  $\omega$  radial excitation.  
 18 Fit to one channel only, neglecting interference with  $\omega$ ,  $\rho(1700)$ .

## PHOTOPRODUCTION

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>• • •</b> We do not use the following data for averages, fits, limits, etc. <b>• • •</b>			
122±63	19 LINK	02K	FOCS 20–160 $\gamma p \rightarrow K^+K^-p$
121±47	19 BUSENITZ	89	TPS $\gamma p \rightarrow K^+K^-X$
80±40	19 ATKINSON	85C	OMEG 20–70 $\gamma p \rightarrow K\bar{K}X$
100±40	19 ASTON	81F	OMEG 25–70 $\gamma p \rightarrow K^+K^-X$

19 We list here a state decaying into  $K^+K^-$  possibly different from  $\phi(1680)$ .

## p $\bar{p}$ ANNIHILATION

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
<b>• • •</b> We do not use the following data for averages, fits, limits, etc. <b>• • •</b>			
143±24	20 AMSLER	06	CBAR 0.9 $\bar{p}p \rightarrow K^+K^-\pi^0$
20 Could also be $\rho(1700)$ .			

## $\phi(1680)$ DECAY MODES

Mode	Fraction ( $\Gamma_i/\Gamma$ )
$\Gamma_1$ $K\bar{K}^*(892) +$ c.c.	dominant
$\Gamma_2$ $K_S^0K\pi$	seen
$\Gamma_3$ $K\bar{K}$	seen
$\Gamma_4$ $K_L^0K_S^0$	
$\Gamma_5$ $e^+e^-$	seen
$\Gamma_6$ $\omega\pi\pi$	not seen
$\Gamma_7$ $\phi\pi\pi$	
$\Gamma_8$ $K^+K^-\pi^+\pi^-$	seen
$\Gamma_9$ $\phi\eta$	
$\Gamma_{10}$ $K^+K^-\pi^0$	

## $\phi(1680)\Gamma(i)\Gamma(e^+e^-)/\Gamma^2(\text{total})$

This combination of a branching ratio into channel ( $i$ ) and branching ratio into  $e^+e^-$  is directly measured and obtained from the cross section at the peak. We list only data that have not been used to determine the branching ratio into ( $i$ ) or  $e^+e^-$ .

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>• • •</b> We do not use the following data for averages, fits, limits, etc. <b>• • •</b>				

0.131±0.059 948 21 AKHMETSHIN 03 CMD2 1.05–1.38  $e^+e^- \rightarrow K_L^0K_S^0$

21 From the combined fit of AKHMETSHIN 03 and MANE 81 also including  $\rho$ ,  $\omega$ , and  $\phi$ . Neither isospin nor flavor structure known. Recalculated by us.

VALUE (units $10^{-6}$ )	EVTS	DOCUMENT ID	TECN	COMMENT
<b>• • •</b> We do not use the following data for averages, fits, limits, etc. <b>• • •</b>				

1.15±0.16±0.01 22 AUBERT 08S BABR 10.6  $e^+e^- \rightarrow K\bar{K}^*(892)\gamma +$  c.c.

3.29±1.57 367 23 BISELLO 91C DM2 1.35–2.40  $e^+e^- \rightarrow K_S^0K^\pm\pi^\mp$

22 From the simultaneous fit to the  $K\bar{K}^*(892) +$  c.c. and  $\phi\eta$  data from AUBERT 08S using the results of AUBERT 07AK.

23 Recalculated by us with the published value of  $B(K\bar{K}^*(892) +$  c.c.)  $\times \Gamma(e^+e^-)$ .

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$\Gamma(\phi\pi\pi)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$				$\Gamma_7/\Gamma \times \Gamma_5/\Gamma$
<u>VALUE</u> (units $10^{-7}$ )	<u>EVTS</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>• • •</b> We do not use the following data for averages, fits, limits, etc. <b>• • •</b>				
1.86 $\pm$ 0.14 $\pm$ 0.21	4.8k	24 SHEN	09 BELL	$10.6 e^+e^- \rightarrow K^+K^-\pi^+\pi^-\gamma$
24 Multiplied by 3/2 to take into account the $\phi\pi^0\pi^0$ mode. Using $B(\phi \rightarrow K^+K^-) = (49.2 \pm 0.6)\%$ .				
$\Gamma(\phi\eta)/\Gamma_{\text{total}} \times \Gamma(e^+e^-)/\Gamma_{\text{total}}$				$\Gamma_9/\Gamma \times \Gamma_5/\Gamma$
<u>VALUE</u> (units $10^{-6}$ )		<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>• • •</b> We do not use the following data for averages, fits, limits, etc. <b>• • •</b>				
0.43 $\pm$ 0.10 $\pm$ 0.09		25 AUBERT	08s BABR	$10.6 e^+e^- \rightarrow \phi\eta\gamma$
25 From the simultaneous fit to the $K\bar{K}^*(892) + \text{c.c.}$ and $\phi\eta$ data from AUBERT 08s using the results of AUBERT 07AK.				

### $\phi(1680)$ BRANCHING RATIOS

$\Gamma(K\bar{K}^*(892) + \text{c.c.})/\Gamma(K_S^0 K\pi)$				$\Gamma_1/\Gamma_2$
<u>VALUE</u>		<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
dominant		MANE	82	$e^+e^- \rightarrow K_S^0 K^\pm\pi^\mp$
$\Gamma(K\bar{K})/\Gamma(K\bar{K}^*(892) + \text{c.c.})$				$\Gamma_3/\Gamma_1$
<u>VALUE</u>		<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>• • •</b> We do not use the following data for averages, fits, limits, etc. <b>• • •</b>				
0.07 $\pm$ 0.01		BUON	82	$DM1 \quad e^+e^-$
$\Gamma(\omega\pi\pi)/\Gamma(K\bar{K}^*(892) + \text{c.c.})$				$\Gamma_6/\Gamma_1$
<u>VALUE</u>		<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<0.10		BUON	82	$DM1 \quad e^+e^-$
$\Gamma(\phi\eta)/\Gamma(K\bar{K}^*(892) + \text{c.c.})$				$\Gamma_9/\Gamma_1$
<u>VALUE</u>		<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
<b>• • •</b> We do not use the following data for averages, fits, limits, etc. <b>• • •</b>				
≈ 0.37		26 AUBERT	08s BABR	$10.6 e^+e^- \rightarrow \text{hadrons}$
26 From the fit including data from AUBERT 07AK.				

### $\phi(1680)$ REFERENCES

SHEN	09	PR D80 031101	C.P. Shen <i>et al.</i>	(BELLE Collab.)
AUBERT	08S	PR D77 092002	B. Aubert <i>et al.</i>	(BABAR Collab.)
AUBERT	07AK	PR D76 012008	B. Aubert <i>et al.</i>	(BABAR Collab.)
AMSLER	06	PL B639 165	C. Amsler <i>et al.</i>	(CBAR Collab.)
AKHMETSHIN	03	PL B551 27	R.R. Akhmetshin <i>et al.</i>	(Novosibirsk CMD-2 Collab.)
Also		PAN 65 1222	E.V. Anashkin, V.M. Aulchenko, R.R. Akhmetshin	
		Translated from YAF 65 1255.	J.M. Link <i>et al.</i>	(FNAL FOCUS Collab.)
LINK	02K	PL B545 50	N.N. Achasov, A.A. Kozhevnikov	
ACHASOV	98H	PR D57 4334	A.B. Clegg, A. Donnachie	(LANC, MCHS)
CLEGG	94	ZPHY C62 455	A. Antonelli <i>et al.</i>	(DM2 Collab.)
ANTONELLI	92	ZPHY C56 15	D. Bisello <i>et al.</i>	(DM2 Collab.)
BISELLO	91C	ZPHY C52 227	S.I. Dolinsky <i>et al.</i>	(NOVO)
DOLINSKY	91	PRPL 202 99	J.K. Busenitz <i>et al.</i>	(ILL, FNAL)
BUSENITZ	89	PR D40 1	D. Bisello <i>et al.</i>	(PADO, CLER, FRAS+)
BISELLO	88B	ZPHY C39 13	L.M. Barkov <i>et al.</i>	(NOVO)
BARKOV	87	JETPL 46 164	M. Atkinson <i>et al.</i>	(BONN, CERN, GLAS+)
		Translated from ZETFP 46 132.	J. Buon <i>et al.</i>	(LALO, MONP)
ATKINSON	85C	ZPHY C27 233	F. Mane <i>et al.</i>	(LALO)
BUON	82	PL 118B 221	D. Aston <i>et al.</i>	(BONN, CERN, EPOL, GLAS, LANC+)
MANE	82	PL 112B 178	P.M. Ivanov <i>et al.</i>	(NOVO)
ASTON	81F	PL 104B 231	F. Mane <i>et al.</i>	(ORSAY)
IVANOV	81	PL 107B 297		
MANE	81	PL 99B 261		

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